

WHAT IS CLAIMED IS:

- 1 1. A method for managing files in a file system, comprising:
2 receiving data for a file;
3 storing the data for the file in a plurality of segments;
4 generating an index associated with the file indicating how the file data maps to
5 the segments;
6 receiving an Input/Output request with respect to an address in the file;
7 using the index for the file to determine the segment including data at the
8 requested address in the file; and
9 accessing the determined segment including the data at the requested address.
- 1 2. The method of claim 1, wherein data is stored in the segments by:
2 writing the received file data to one segment; and
3 writing further received data for the file to subsequent segments if the last
4 segment to which the received data was written has no more available space.
- 1 3. The method of claim 1, wherein each segment has a fixed byte length,
2 wherein the index provides a segment order indicating an order in which file data is
3 written to the segments, and wherein the index for the file is used to determine the
4 segment including data at the requested address in the file by:
5 determining an offset into the file including the data at the requested address; and
6 determining an integer quotient value resulting from the offset into the file divided
7 by the fixed byte length, wherein the segment including the data at the requested address
8 is the segment at the integer quotient value in the segment order.
- 1 4. The method of claim 3, further comprising:
2 receiving user input indicating the fixed byte length of each segment.

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1 9. The method of claim 6, wherein releasing the segment comprises:
2 storing a partial version of the released segment including less than all data in the
3 segment, wherein the segment data not in the partial version is stored in the secondary
4 storage, wherein the partial version remains on the primary storage after the segment is
5 released.

1 10. The method of claim 9, wherein the partial version of the determined
2 segment is on the primary storage and wherein accessing the determined segment
3 including the requested address further comprises:
4 accessing the partial version of the determined segment on the primary storage to
5 access the data therein;
6 reaching the end of the partial version when accessing data therein;
7 staging from the secondary storage to the primary storage data from the
8 determined segment that is not in the partial version; and
9 accessing the data from the determined segment staged from the secondary storage
10 to the primary storage.

1 11. The method of claim 9, wherein the partial version is stored only for a
2 first segment of the segments associated with the file.

1 12. The method of claim 6, further comprising:
2 accessing data at the end of the segment, wherein the I/O request requires further
3 file data after accessing the end of the segment;
4 determining from the index a next segment including file data following the file
5 data at the end of the segment data; and
6 accessing the next segment in the primary storage to access the further required
7 file data.

1 13. The method of claim 6, further comprising:
2 maintaining metadata for each segment that is also maintained for files in the file
3 system; and
4 using the metadata for segments and files to determine when to copy segments
5 and files to the secondary storage and when to release segments and files in the primary
6 storage.

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1 14. The method of claim 13, wherein segments and files in the primary storage
2 are released according to their metadata if used space in the primary storage reaches a
3 threshold level.

1 15. The method of claim 6, wherein the file data in all the segments for the file
2 is capable of being larger than a storage capacity of the primary storage.

1 16. The method of claim 6, further comprising:
2 reading data from one target segment on the secondary storage;
3 determining whether a stage attribute is specified indicating a number of segments
4 to stage ahead; and
5 initiating read requests to stage the number of subsequent segments following the
6 target segment from the secondary storage to the primary storage.

1 17. The method of claim 16, further comprising:
2 receiving user input indicating the number of segments to stage ahead.

1 18. The method of claim 1, wherein the segment does not have a file name and
2 is not represented as a file in the file system.

1 19. The method of claim 1, wherein the index is stored in the file, wherein no
2 user data is stored in the file and all the user data is distributed in the segments.

1 20. A method for managing files in a primary and secondary storage, wherein
2 the secondary storage is comprised of a plurality of drives and storage devices capable of
3 being mounted on the drives, comprising:
4 receiving data for a file;
5 storing the data for the file in a plurality of segments;

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6 generating an index associated with the file indicating how file data maps to
7 segments; and
8 writing each segment to one of the drives, wherein segments are written to
9 multiple of the drives to distribute the segments across multiple storage devices.

1 21. The method of claim 20, wherein multiple segments are written in parallel
2 to multiple storage devices in multiple drives.

1 22. The method of claim 20, further comprising
2 reading segments on multiple storage devices from multiple drives to stage
3 multiple segments in parallel into the primary storage.

1 23. The method of claim 20, wherein the drives comprise tape drives and
2 wherein the storage devices comprise tape cartridges.

1 24. A system for managing files, comprising:
2 a computer readable medium;
3 a storage system;
4 means for receiving data for a file;
5 means for storing the data for the file in a plurality of segments in the storage
6 device;
7 means for generating an index in the computer readable medium associated with
8 the file indicating how the file data maps to the segments;
9 means for receiving an Input/Output request with respect to an address in the file;
10 means for using the index for the file to determine the segment including data at
11 the requested address in the file; and
12 means for accessing the determined segment including the data at the requested
13 address.

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1 29. The system of claim 24, wherein the storage system comprises a primary
2 storage, further comprising:
3 a secondary storage;
4 means for copying at least one of the segments in the primary storage onto the
5 secondary storage; and

6 means for releasing at least one of the segments copied to the secondary storage,
7 wherein space used by the released segment in the primary storage is available for use.

1 30. The system of claim 29, wherein as a result of releasing one or more
2 segments, different segments for one file are capable of being stored in the primary
3 storage and the secondary storage.

1 31. The system of claim 29, wherein the means for accessing the determined
2 segment including the requested address further performs:
3 determining whether the determined segment is available in the primary storage;
4 and
5 copying the determined segment from the secondary storage to the primary storage
6 if the determined segment is not available in the primary storage.

1 32. The system of claim 29, wherein the means for releasing the segment
2 performs:
3 storing a partial version of the released segment including less than all data in the
4 segment, wherein the segment data not in the partial version is stored in the secondary
5 storage, wherein the partial version remains on the primary storage after the segment is
6 released.

1 33. The system of claim 32, wherein the partial version of the determined
2 segment is on the primary storage and wherein the means for accessing the determined
3 segment including the requested address further performs:
4 accessing the partial version of the determined segment on the primary storage to
5 access the data therein;
6 reaching the end of the partial version when accessing data therein;

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1 35. The system of claim 29, further comprising:
2 means for accessing data at the end of the segment, wherein the I/O request
3 requires further file data after accessing the end of the segment;
4 means for determining from the index a next segment including file data
5 following the file data at the end of the segment data; and
6 means for accessing the next segment in the primary storage to access the further
7 required file data.

1 36. The system of claim 29, further comprising:
2 means for maintaining metadata for each segment that is also maintained for files
3 in the file system; and
4 means for using the metadata for segments and files to determine when to copy
5 segments and files to the secondary storage and when to release segments and files in the
6 primary storage.

1 37. The system of claim 24, wherein segments and files in the primary storage
2 are released according to their metadata if used space in the primary storage reaches a
3 threshold level.

10 means for writing each segment to one of the drives, wherein segments are written
11 to multiple of the drives to distribute the segments across multiple storage devices.

1 44. The system of claim 43, wherein multiple segments are written in parallel
2 to multiple storage devices in multiple drives.

1 45. The system of claim 43, further comprising
2 means for reading segments on multiple storage devices from multiple drives to
3 stage multiple segments in parallel into the primary storage.

1 46. The system of claim 43, wherein the drives comprise tape drives and
2 wherein the storage devices comprise tape cartridges.

1 47. An article of manufacture for managing files in a file system, comprising:
2 receiving data for a file;
3 storing the data for the file in a plurality of segments;
4 generating an index associated with the file indicating how the file data maps to
5 the segments;
6 receiving an Input/Output request with respect to an address in the file;
7 using the index for the file to determine the segment including data at the
8 requested address in the file; and
9 accessing the determined segment including the data at the requested address.

1 48. The article of manufacture of claim 47, wherein data is stored in the
2 segments by:
3 writing the received file data to one segment; and
4 writing further received data for the file to subsequent segments if the last
5 segment to which the received data was written has no more available space.

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1 49. The article of manufacture of claim 47, wherein each segment has a fixed
2 byte length, wherein the index provides a segment order indicating an order in which file
3 data is written to the segments, and wherein the index for the file is used to determine the
4 segment including data at the requested address in the file by:

5 determining an offset into the file including the data at the requested address; and
6 determining an integer quotient value resulting from the offset into the file divided
7 by the fixed byte length, wherein the segment including the data at the requested address
8 is the segment at the integer quotient value in the segment order.

1 50. The article of manufacture of claim 49, further comprising:
2 receiving user input indicating the fixed byte length of each segment.

1 51. The article of manufacture of claim 47, further comprising:
2 providing a segment size that is at least greater than a byte size of a largest section
3 within the file; and
4 writing each file section to one segment.

1 52. The article of manufacture of claim 47, further comprising:
2 storing the segments in a primary storage;
3 copying at least one of the segments in the primary storage onto a secondary
4 storage; and
5 releasing at least one of the segments copied to the secondary storage, wherein
6 space used by the released segment in the primary storage is available for use.

1 53. The article of manufacture of claim 52, wherein as a result of releasing one
2 or more segments, different segments for one file are capable of being stored in the
3 primary storage and the secondary storage.

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1 57. The article of manufacture of claim 55, wherein the partial version is
2 stored only for a first segment of the segments associated with the file.

1 58. The article of manufacture of claim 52, further comprising:
2 accessing data at the end of the segment, wherein the I/O request requires further
3 file data after accessing the end of the segment;
4 determining from the index a next segment including file data following the file
5 data at the end of the segment data; and
6 accessing the next segment in the primary storage to access the further required
7 file data.

1 59. The article of manufacture of claim 52, further comprising:
2 maintaining metadata for each segment that is also maintained for files in the file
3 system; and
4 using the metadata for segments and files to determine when to copy segments
5 and files to the secondary storage and when to release segments and files in the primary
6 storage.

1 60. The article of manufacture of claim 59, wherein segments and files in the
2 primary storage are released according to their metadata if used space in the primary
3 storage reaches a threshold level.

1 61. The article of manufacture of claim 52, wherein the file data in all the
2 segments for the file is capable of being larger than a storage capacity of the primary
3 storage.

1 62. The article of manufacture of claim 52, further comprising:
2 reading data from one target segment on the secondary storage;
3 determining whether a stage attribute is specified indicating a number of segments
4 to stage ahead; and

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5 initiating read requests to stage the number of subsequent segments following the
6 target segment from the secondary storage to the primary storage.

1 63. The article of manufacture of claim 62, further comprising:
2 receiving user input indicating the number of segments to stage ahead.

1 64. The article of manufacture of claim 47, wherein the segment does not have
2 a file name and is not represented as a file in the file system.

1 65. The article of manufacture of claim 47, wherein the index is stored in the
2 file, wherein no user data is stored in the file and all the user data is distributed in the
3 segments.

1 66. An article of manufacture for managing files in a primary and secondary
2 storage, wherein the secondary storage is comprised of a plurality of drives and storage
3 devices capable of being mounted on the drives, by:
4 receiving data for a file;
5 storing the data for the file in a plurality of segments;
6 generating an index associated with the file indicating how file data maps to
7 segments; and
8 writing each segment to one of the drives, wherein segments are written to
9 multiple of the drives to distribute the segments across multiple storage devices.

1 67. The article of manufacture of claim 66, wherein multiple segments are
2 written in parallel to multiple storage devices in multiple drives.

1 68. The article of manufacture of claim 66, further comprising

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1 69. The article of manufacture of claim 66, wherein the drives comprise tape
2 drives and wherein the storage devices comprise tape cartridges.

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